SPIRE

SUBJECT: **Statement of Work for SPIRE Cold Blackbody and Cryostat Filters**

PREPARED BY: **D.L. Smith**

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RAL Approval **K. King** **Date:**

Cardiff Approval **M. Griffin** **Date:**

Distribution

RAL Dr K .King
Dr B. Swinyard

Cardiff Prof. M. Griffin
Dr P Hargrave

Change Record

Issue	Date	Affected Pages	Reason For Change
0.1	24-July-2001	All	First draft for comment
0.2	12-Oct-2001	6	Milestone Dates Revised
		10	Drawing of Blackbody System Added
		8-11	WP1000 split into 4 separate packages
		12	Schematic for filters added

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Glossary

SPIRE	Spectral and Photometric Imaging REceiver
ITS90	International Temperature Scale of 1990
CBB	Cold BlackBody
RAL	Rutherford Appleton Laboratory
UCW	University of Wales, Cardiff

1. REFERENCES

1.1 Applicable Documents

	Title	Author	Reference	Date
AD 1	SPIRE AIV Test Facility Requirements Specification	D.L. Smith	SPIRE-RAL-PRJ-000463 Issue 1.3	10-April-2001
AD 2	SPIRE Cryostat Interface Drawings	M.R.Harman	KG0710-003	14-Aug-2001
AD3	Cryostat Cold Blackbody Requirements	D.L. Smith	SPIRE-RAL-NOT-000903 Issue 0.1	10-Oct-2001
AD4	Calibration Cryostat Filter Model	D.L. Smith	SPIRE-RAL-NOT-000902 Issue 1.1	08-Oct-2001
AD5	Cryostat Windows and Filters	D.J. Simmons	KG0710-100 Draft	04-Oct-2001

1.2 Reference Documents

	Title	Author	Reference	Date
RD 3	The International Temperature Scale of 1990		http://www.its-90.com	

2. INTRODUCTION

A calibration cryostat is being developed for the SPIRE AIV testing at RAL (AD1) to enable the cryogenic calibration and characterisation of the instrument. The cryostat will house the SPIRE FPU and two JFET boxes, and will simulate the thermal environment presented by Herschel, namely 1.7K, 4.2K and 9-15K. The SPIRE instrument will view 'hot' calibration sources through an exit window on the cryostat via a telescope simulator. A cryogenic (4K-40K) blackbody mounted within the cryostat will provide an absolute calibration reference. This document describes the work packages for Cardiff University to develop the cryogenic blackbody and cryostat optical filters.

3. MILESTONES

Milestone	Ref.	Resp.	Needed	Planned	Actual
Cold BB Delivered	AD1	UWC	01-05-01		
Cold BB Control Electronics Delivered	AD1	UWC	01-05-01		
Cold BB Control Software Delivered	AD1	UWC	01-05-01		
Filters Delivered	AD1	UWC	01-06-01		

4. COLD-BLACKBODY

A cryogenic blackbody is required to provide an absolute calibration source that can be viewed 'directly' by SPIRE (i.e. not via cryostat filters, window or telescope simulator optics). The source will uniformly illuminate all SPIRE detectors simultaneously to aid flat field characterisations, and will operate over the range 4.2K to 40K to allow dynamic range, gain and linearity measurements. The blackbody will be mounted alongside SPIRE within the 10K environment of the cryostat off a 4.2K cold finger. A flip-mirror will be used to bring the blackbody into SPIRE's field of view when required and hide when external sources are to be used. The detailed requirements for the blackbody are defined in AD1 and AD3, and the interface to the calibration cryostat in AD2.

The blackbody heaters, shutter and thermometry will be controlled and monitored from the Test Facility Control System, via a dedicated electronics unit situated outside the cryostat, (see figure 1). The electronics unit will house the power supplies and data-logging interface for the heater current, thermometers and contact switches. The interface to the blackbody unit will be via a TBD way vacuum connector on the cryostat wall. RAL will provide the cryogenic harness between the vacuum wall and blackbody unit to Cardiff's specification. The interface to the TFCS will be via a National Instruments data acquisition card (type TBD). A Labview® virtual instrument running on the TFCS will control and monitor the electronics. This software will have an interface to the TFCS data handling system.

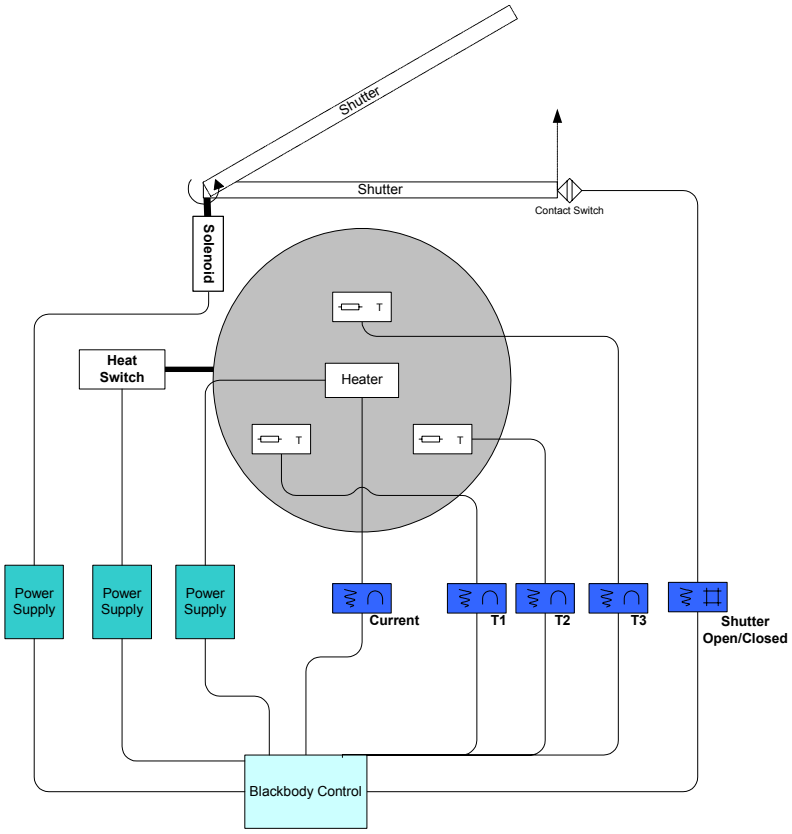

Figure 1: Schematic for cold-blackbody control electronics and software.

Work Package Description							
Project :	**SPIRE Calibration Facility**	**Phase**:		**WP Number**:		1100	
WP Title:	**Cold Blackbody**			**Issue**:		0.2	
Assigned To:	Dr Peter Hargrave, University of Wales, Cardiff			**Issue Date**:		12-Oct-2001	
Start Event:	Project Start	**and/or Planned Start Date:**				01-Jul-2001	
End Event:	Delivery of blackbody	**and/or Planned End Date:**				01-May-2002	
Additional partners	Mr P. Collins, University of Wales, Cardiff Prof. P. Ade, Unversity of Wales, Cardiff		**Sheet**:	1	Of	1	
			Estimated Effort:				

Objectives:

- Design and Manufacture cryogenic blackbody for SPIRE calibration facility

Task Description:

- Design and build a blackbody to operate over the temperature range 4K to 20K to fit within the SPIRE calibration cryostat.
- Calibrate blackbody temperatures and radiances.
- Specify wiring harness from blackbody to cryostat interface

Inputs:

- Requirements Specification
- Interface Drawings

Outputs:

- Blackbody design spec
- Blackbody drawings – including interface drawings
- Blackbody unit – incorporating the cold plate, thermometers, heaters, heat switch, internal harness
- Wiring specification for harness from blackbody to vacuum wall.
- Calibration report
- Integration procedure
- Acceptance test plan and procedures
- User Manual

Work Package Description							
Project :	**SPIRE Calibration Facility**	**Phase**:		**WP Number**:		1200	
WP Title:	**Cold Blackbody Electronics Unit**			**Issue**:		0.2	
Assigned To:	Dr Peter Hargrave, University of Wales, Cardiff			**Issue Date**:		12-Oct-2001	
Start Event:	Project Start	**and/or Planned Start Date:**				01-Jul-2001	
End Event:	Delivery of electronics	**and/or Planned End Date:**				01-May-2002	
Additional partners	Mr P. Collins, University of Wales, Cardiff Prof. P. Ade, Unversity of Wales, Cardiff	**Sheet**:	1	Of	1		
		Estimated Effort:					

Objectives:

- Design and manufacture control electronics unit for cryogenic blackbody unit.

Task Description:

- Design control unit for blackbody
- Test control unit with cryogenic blackbody

Inputs:

- Requirements Specification
- Interface Drawings

Outputs:

- Control unit
- Integration procedure
- Design Specification
- Acceptance test plan and procedures
- User Manual

Work Package Description							
Project :	**SPIRE Calibration Facility**	**Phase**:		**WP Number**:		1300	
WP Title:	**Cold Blackbody Control Software**			**Issue**:		0.2	
Assigned To:	Dr Peter Hargrave, University of Wales, Cardiff			**Issue Date**:		12-Oct-2001	
Start Event:	Project Start	**and/or Planned Start Date:**				01-Jul-2001	
End Event:	Delivery of software	**and/or Planned End Date:**				01-May-2002	
Additional partners	Mr P. Collins, University of Wales, Cardiff Prof. P. Ade, Unversity of Wales, Cardiff	**Sheet**:	1	of	1		
		Estimated Effort:					

Objectives:

- Produce Labview® application to control cryogenic blackbody

Task Description:

- Write the control and monitoring software for the blackbody in Labview with interface to TFCS

Inputs:

- Requirements Specification
- Interface Specification

Outputs:

- Blackbody software documents including:
  - User Requirements (URD)
  - Software System Design (SSD)
  - Acceptance Test Plan and Procedures
  - Software User Manual (SUM)
- Blackbody Control Software on CD-ROM

Work Package Description					
Project :	**SPIRE Calibration Facility**	**Phase**:		**WP Number**:	1400
WP Title:	**Post Delivery Support**			**Issue**:	0.2
Assigned To:	Dr Peter Hargrave, University of Wales, Cardiff			**Issue Date**:	12-Oct-2001
Start Event:	Delivery of Cold Blackbody	**and/or Planned Start Date:**			01-May-2002
End Event:	Cryostat Comissioned	**and/or Planned End Date:**			01-Aug-2002
Additional partners	Mr P. Collins, University of Wales, Cardiff Prof. P. Ade, Unversity of Wales, Cardiff	**Sheet**:	1	of	1
		Estimated Effort:			

Objectives:

- Post delivery support of cold-blackbody

Task Description:

- Integrate the cold-blackbody in calibration cryostat
- Integrate control electronics in test system
- Install control software on TFCS and support integration tests

Inputs:

- Cold Blackbody, electronics and control software
- Test Plan

Outputs:

5. CRYOSTAT FILTERS

Under nominal flight-operations conditions, the radiometric flux entering the SPIRE optics will be dominated by the signal from the 80K telescope with emissivity of 0.04. Filters are required in the cryostat at the 77K, 10K and 4K stages to exclude the thermal infrared from the 300K environment and to simulate the predicted in-flight photometric fluxes, (Figure 2).

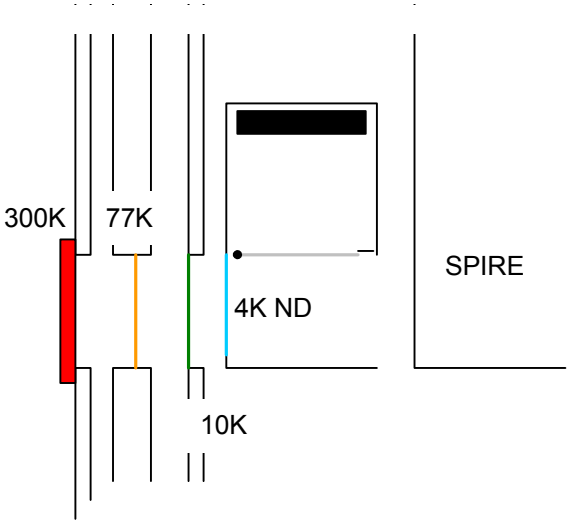

Figure 2: Schematic showing filter arrangement for calibration cryostat

Work Package Description							
Project :	**SPIRE Calibration Facility**	**Phase**:		**WP Number**:		2000	
WP Title:	**Cryostat Filters**			**Issue**:		0.2	
Assigned To:	Dr Peter Hargrave, University of Wales, Cardiff			**Issue Date**:		12-Oct-2001	
Start Event:	Project Start	**and/or Planned Start Date:**				01-Jul-2001	
End Event:	Delivery of filters	**and/or Planned End Date:**				01-Jun-2002	
Additional partners	Mr P. Collins, University of Wales, Cardiff Prof. P. Ade, University of Wales, Cardiff		**Sheet**:	1	of	1	
			Estimated Effort:				

Objectives:

- Design and Manufacture optical filters for SPIRE calibration facility

Task Description:

- Design and manufacture filters for the SPIRE calibration cryostat to operate at 77K, 10K and 4K.
- Model the heat fluxes at each temperature stage of the cryostat so that the heat load on the instrument can be estimated.
- Model the radiometric signal entering the instrument over the wavelength range 1.0 to 1000μm
- Mount the filters in the frames provided by RAL
- Calibrate the filter transmissions over the wavelength range from 1.0 to 1000μm.

Inputs:

- Requirements Specification
- Interface Drawings
- Filter mounting frames from RAL

Outputs:

- Design specification for the filters – including predicted transmissions and fluxes.
- Mounted filters
- Calibration report